Selection of Chemical Protective Gloves

Guidance for In-Service Engineering Agent (ISEA)
Developers of Shipboard Maintenance Procedures

Training Developed by the
Navy PPE Working Group
and
Naval Safety Center
05 March 2013

"Quick Notes"

- View this training presentation with Instructor Notes visible. They provide additional examples and detail

- The presentation contains links that are highlighted in blue
  - You may need to copy/paste the links into your browser as you can't click on them unless the presentation is in "Slideshow" mode

Background and Purpose of Training

- Navy Personal Protective Equipment (PPE) Working Group reviewed processes used by In-Service Engineering Agents (ISEA) to assign chemical protective glove requirements in Maintenance Requirement Cards (MRC)
  - The review indicated inconsistent expertise of ISEAs with regard to selection of chemical protective gloves
  - Inappropriate glove recommendations specified for some tasks which could increase potential for occupational dermatitis and other injuries

Background and Purpose of Training

- Bureau of Labor Statistics (BLS) data estimates that 12% of occupational illnesses are skin disorders
  - Risk factors for personnel include skin exposure to chemicals, allergens, and work in wet environments
  - Chemicals may permeate (pass through) gloves without apparent damage to the glove and expose personnel
  - See Notes

- PPE Working Group developed this training to support ISEAs in selection of appropriate chemical protective gloves
  - Updated training and review of MRC cards with regard to protective equipment required for ISEAs on the basis of the above findings

Training Objectives

- Ensure that ISEAs have the knowledge to specify the correct type of chemical protective gloves
- Illustrate the importance of selecting the correct chemical protective gloves to best protect Navy personnel
- Educate ISEAs on the various types of chemical protective gloves available and their advantages and limitations
- Explain the chemical protective properties of different glove materials
- Offer a suggested glove selection process and illustrate with examples
- Identify sources of technical assistance

Common Issues

- Chemical resistance provided by different glove types varies greatly
- The appropriate glove type is based on the chemical being used
- Language used in Fed Specs and other references is oftentimes vague
- Present National Stock Number (NSN) and Mil Spec information is dated
  - Specs for chemical protective gloves are non-specific and may not provide protection for solvents being used
  - NSN 8415-00-266-8673 (Gloves, Rubber, Industrial) is commonly selected even though other gloves types can offer better protection at less cost
  - Neoprene provides protection for the widest range of solvents, but no NSNs/Fed Specs exist for neoprene gloves (We're working with DLA to get them added)
  - Current spec Mil DTL 32066 Gloves, Rubber, Industrial July 2000 is "active", although nomenclature and test issues have been reported to the developing activity

Why is Selecting the Appropriate Glove Type so Important?

- Ensure that the glove selected actually protects against the chemical used
  - Different glove materials allow chemicals to penetrate with or without visible damage to the glove
- Bulky and/or uncomfortable gloves hinder task performance
  - They’re likely not to be used except during inspections
  - Glove thickness should reflect the likely hazard

References and Requirements

- OSHA Protective Equipment Standard
  - 29 CFR 1910.132
    - Requires that PPE be specified in writing and users trained appropriately on that PPE
- OPNAV Instructions
  - OPNAVINST 5100.23G Navy Safety and Occupational Health Program Manual (Chapter 20)
  - OPNAVINST 5100.19E Navy Safety and Occupational Health Program Manual for Forces Afloat (Chapter B12)
- Mil Std 3034 (2011) Reliability Centered Maintenance
- NAVSEA S9081-AB-GIB-010, latest version, Reliability-Centered Maintenance (RCM) Handbook

Navy PPE Training Requirements

- *OPNAVINST 5100.23G, paragraph 2013(a)*
  - Activities shall provide training to each employee who is required to use PPE to include at least the following:
    (1) When PPE is necessary
    (2) What PPE is necessary
    (3) How to properly don, doff, adjust and wear PPE
    (4) The limitations of the PPE
    (5) The proper care, maintenance, useful life, storage and disposal of the PPE
    (6) Ability to recognize that defective or damaged PPE shall not be used

- *OPNAVINST 5100.19E, paragraph B1202(c)*
  - Division officers shall ensure that assigned personnel are adequately trained on the type and proper use of PPE required at their work stations...

Chemical Protective Glove Selection

- ISEAs should cross-check key references to determine the most appropriate glove for a given maintenance task. References include:
  - Hazardous Material User's Guide (HMUG)
    - Incorporated into Naval Ship's Technical Manual (NSTM) 670, Vol II
  - Product Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS)
  - PPE Working Group Chemical Protective Glove Matrix
  - Glove manufacturer websites
- ISEAs need to be able to address common knowledge gaps among users
  - Glove materials differ in resistance to penetration by solvents (natural latex rubber, butyl "rubber" and neoprene are very different materials with different chemical resistance properties)
  - "Rubber" glove materials need to be defined
  - Gloves can permit solvent permeation without apparent damage

Chemical Protective Glove Types

- Manufacturers make chemical protective gloves from many different materials
  - Nitrile
  - Natural latex rubber
  - Synthetic rubbers
    - Butyl rubber
    - Neoprene
    - Viton ®
  - Polyvinyl Chloride (PVC)
  - Polyvinyl alcohol (PVA)
  - Multi-layer laminate
  - … and several others
- How do you determine which is appropriate?


SILVER SHIELD

Safety Data Sheets

- Each chemical and chemical product is required to have a safety data sheet
  - Material Safety Data Sheet (MSDS) and/or Safety Data Sheet (SDS)
  - MSDS/SDS are stored in the Hazardous Materials Information Resource System (HMIRS)

- MSDS/SDS provide important information
  - Chemical composition
  - Safety precautions
  - Health hazards and symptoms of overexposure
  - Recommended PPE

Hazardous Materials User's Guide (HMUG)

- Was OPNAVINST 5100.28 until June 2012
- HMUG has now been incorporated into Naval Ship's Technical Manual (NSTM) 670, Vol. II
- HMUG Contains PPE recommendations and information for 20 chemical groups
  - Eye protection
  - Gloves
  - Clothing
  - Foot protection
  - Respiratory Protection

Chemical Protective Glove Matrix

- The Navy PPE Working Group developed a Chemical Protective Glove matrix based on the NSTM 670 Hazardous Material User's Guide (HMUG)

- If the Maintenance Requirement Card (MRC) required glove is unavailable, the matrix helps maintenance personnel and their supervisors select a good alternative

Chemical Protective Glove Matrix

- "The Matrix" contains helpful information
  - Instructions on how the matrix should be used
  - Photos of various glove types
  - NAVSEA's Standard PMS Item Name (SPIN)
  - National Stock Number (NSN) information
  - Comparison of protection capabilities of various glove types against many common chemical hazards
- The matrix can be downloaded from:
  - Naval Safety Center's Safety Officer Training Materials web page
    (see notes)
  - NAVSEA's Maritime DC and PPE Information Center web page
    (see notes)

NSTM 670 (Vol. 2) HMUG Chemical Group #	NSTM 670 (Vol. 2) HMUG Chemical Group Name	NSTM 670 (Vol. 2) HMUG Hand Protection (Chemical) Recommendation (See Note 1 below)	Chemical Resistant Glove Type						
			Nitrile (Green "OTTO Fuel") Gauntlet Gloves	Neoprene Gloves	Butyl (Synthetic) Rubber "Toxicological Agents Protective" Gloves	PVC Coated Rubber (Chemical/Oil Protective) Gloves	Black Natural Latex Rubber "Industrial" Gloves	8-mil Disposable Nitrile Gloves	4-mil Disposable Nitrile Gloves
			SPIN: 02006	SPIN: TBD	SPIN: 02005	SPIN: 00517	SPIN: 00525	SPIN: 02026 (8 mil thick)	SPIN: 1793 (4 mil thick
Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs.								NOTE: Incidental (Splash) contact only. Replace with new glove if contamination	
Group 1	Acids	Acid-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 2	Alkalies/Bases/Caustics	Rubber	More Info	More Info	Y	Y	Y	More Info	More Info
Group 3	Detergents/Soaps	Rubber	Y	Y	Y	Y	Y	Y	Y
Group 4	Photographic Chemicals	Rubber	More Info	More Info	Y	Y	Y	More Info	More Info
Group 5	Adhesives	Neoprene or Rubber	More Info	Y	More Info	N	More Info	More Info	More Info
Group 6	Cleaning Compounds	Rubber	Y	Y	Y	Y	Y	Y	Y
Group 7	Aerosols	Neoprene	More Info	Y	More Info	N	More Info	More Info	More Info
Group 8	Paint Materials (Oil-Based)	Neoprene for Oil-Based Paints Any Protective Glove for Water-Based	More Info	Y	More Info	N	More Info	More Info	More Info
Group 9	Solvents	Solvent-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 10	Fuels	Neoprene, Nitrile, or Natural Rubber	Y	Y	More Info	Y	More Info	Y	Y
Group 11	Lubricants/Oils	Oil-Proof Neoprene or Rubber	More Info	Y	More Info	N	More Info	More Info	More Info
Group 12	Hydraulic Fluids	Neoprene for Petroleum-Based Fluids Butyl Rubber for Synthetic, Fire Resistant Fluids	More Info	OK (Petroleum-Based Fluids)	OK (Fire-resistant Fluids)	N	More Info	More Info	More Info
Group 13	Greases	Protective Gloves	Y	Y	Y	Y	Y	Y	Y
Group 14	Polish/Wax Compounds	Protective Gloves	Y	Y	Y	Y	Y	Y	Y
Group 15	Corrosion Preventive Compounds	Rubber	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 16	Antifreeze	Chemical Resistant Neoprene, Natural Latex, or Butyl	More Info	Y	Y	N	Y	More Info	More Info
Group 17	Compressed Gases	None	Consult MSDS for proper PPE, if applicable						
Group 18	Oxidizers	Neoprene	More Info	Y	More Info	N	More Info	More Info	More Info
Group 19	Fluorescent Lamps	Protective Gloves	Y	Y	Y	Y	Y	Y	Y
Group 20	Heavy Metals	Protective Gloves	Y	Y	Y	Y	Y	Y	Y

Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing th

Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.

Glove is recommended by NSTM 670 (Vol. 2) HMUG

Glove is acceptable under certain conditions listed in the block

Glove is not recommended for protection against chemicals in this group

Back to the "How to Use This Matrix" Page

Chemical	Chemical Protection Offered by Various Glove Materials*				
	Neoprene	Natural Latex/Rubber	Butyl	Nitrile	Multi-Layer Laminate
Acetaldehyde	Very Good	Good	Very Good	Good	Excellent
Acetic Acid	Very Good	Good	Very Good	Good	Excellent
Acetone	Good	Very Good	Very Good	Poor	Excellent
Ammonium Hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Amyl Acetate	Fair	Poor	Fair	Poor	Not Tested
Aniline	Good	Fair	Fair	Poor	Excellent
Benzaldehyde	Fair	Fair	Good	Good	Insufficient Data
Benzene	Poor	Poor	Poor	Fair	Excellent
Butyl Acetate	Good	Fair	Fair	Poor	Excellent
Butyl Alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Carbon Disulfide	Fair	Fair	Fair	Fair	Excellent
Carbon Tetrachloride	Fair	Poor	Poor	Good	Excellent
Castor Oil	Fair	Poor	Fair	Very Good	Not Tested
Chlorobenzene	Fair	Poor	Fair	Poor	Excellent
Chloroform	Good	Poor	Poor	Fair	Excellent
Chloronapthalene	Fair	Poor	Fair	Fair	Excellent
Chromic Acid (50% strength)	Fair	Poor	Fair	Fair	Excellent
Citric Acid (10% strength)	Very Good	Very Good	Very Good	Very Good	Not Tested
Cyclohexanol	Good	Fair	Good	Very Good	Excellent
Dibutyle Pthalate	Good	Poor	Good	Good	Excellent
Diesel Fuel	Good	Poor	Poor	Very Good	Not Tested
Diisobutyle Ketone	Poor	Fair	Good	Poor	Excellent
Dimethylformamide	Fair	Fair	Good	Good	Excellent
Dioctyl Pthalate	Good	Poor	Fair	Very Good	Insufficient Data
Dioxane	Very Good	Good	Good	Good	Excellent
Epoxy resins, dry	Very Good	Very Good	Very Good	Very Good	Not Tested
Ethyl acetate	Good	Fair	Good	Fair	Excellent
Ethyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Ethyl ether	Very Good	Good	Very Good	Good	Excellent
Ethylene dichloride	Fair	Poor	Fair	Poor	Excellent
Ethylene glycol	Very Good	Very Good	Very Good	Very Good	Excellent
Formaldehyde	Very Good	Very Good	Very Good	Very Good	Excellent
Formic acid	Very Good	Very Good	Very Good	Very Good	Very Good
Freon 11	Good	Poor	Fair	Good	Not Tested
Freon 12	Good	Poor	Fair	Good	Not Tested

Example Glove Selection Process

- Identify materials to be used and their chemical composition
- Assess the potential exposure risk
- Review pertinent resources
- Consider worker performance and comfort

Identify materials and chemical composition

- Safety Data Sheets (MSDS or SDS) can help

- Important to have a general sense of the product composition
  - What chemicals make up the product?
  - Remember, not all glove types protect equally against all chemicals

Assess Potential Exposure Risk

- Is the exposure risk high?
  - Immersion or “slathering” (such as in grease application) in chemical?
  - Chemical contamination on glove for long period of time?

- Is the exposure risk low
  - Incidental splashes (little or no direct contact with chemical expected)?
  - Gloves changed quickly in case of contamination

Review Pertinent Resources

- Review MSDS
  - Some will give specific glove type recommended (such as “use nitrile gloves” (Good!)
  - Others will be non-specific such as “use protective gloves” (Bad! Too vague!)

- HMUG
  - Likewise, the HMUG guidance is specific for some chemical groups, vague for others

- Chemical Protective Glove Matrix
  - Can help determine appropriate options if MSDS and/or HMUG recommendations are too vague

Worker Performance and Comfort

- Is a high level of dexterity needed?
- A thick, unwieldy glove may be more protective, but may inhibit worker
  - "Better" protection means nothing if the worker has to remove the glove to perform the task
  - Sometimes a thinner glove is the best option
    - Particularly if the likely exposure risk is low

Let's Run Through a Few Scenarios

Example #1- Corrosion Prevention

- Suppose an MRC is being developed that requires the use of Corrosion Preventive Compound (SPIN #00322)
- Maintenance task involves brushing corrosion prevention compound on parts
- Suppose the risk of hand exposure is low (incidental splash potential)
- Which glove provides the appropriate protection?

Example #1- Corrosion Prevention

- Step #1: Determine specific composition of compound
  - MSDS indicates aliphatic mineral spirits (petroleum distillates) and several chlorofluorocarbon (CFC) propellants
- Step #2: Assess the potential exposure risk
  - Maintenance task involves no immersion of hands in material, but there is some risk of incidental splashes

Example #1- Corrosion Prevention

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Corrosion Preventive Compounds = HMUG Group #15
    - HMUG Group #15 recommends “Rubber Gloves” (vague… there are several different types of rubber)
  - Cross-check glove recommendation in product MSDS
    - MSDS recommends “Oil Impervious” (vague!) gloves

Example #1- Corrosion Prevention

- Step #3 (cont'd): Cross-check aliphatic mineral spirits (petroleum distillates) against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #15
  - Scroll down to "Petroleum Distillates"
  - Select appropriate glove type
    - Multi-layer laminate- Excellent
    - Nitrile- Very Good
    - Neoprene- Good
    - Natural latex- Not Recommended
    - Butyl Rubber- Not Recommended

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			SPIN: 02086	SPIN: TBD	SPIN: 02085	SPIN: 00517	SPIN: 00525	SPIN: 02826 (8 mil thick)	SPIN: 1793 (4 mil thick
Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs.								NOTE: Incidental (Splash) contact only. Replace with new glove if contamination	
Group 1	Acids	Acid-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 2	Alkalies/Bases/Caustics	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 3	Detergents/Soaps	Rubber	T	T	T	T	T	T	T
Group 4	Photographic Chemicals	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 5	Adhesives	Neoprene or Rubber	More Info	T	More Info	N	More Info	More Info	More Info
Group 6	Cleaning Compounds	Rubber	T	T	T	T	T	T	T
Group 7	Aerosols	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
Group 8	Paint Materials (Oil-Based)	Neoprene for Oil-Based Paints Any Protective Glove for Water-Based	More Info	T	More Info	N	More Info	More Info	More Info
Group 9	Solvents	Solvent-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 10	Fuels	Neoprene, Nitrile, or Natural Rubber	T	T	More Info	T	More Info	T	T
Group 11	Lubricants/Oils	Oil-Proof Neoprene or Rubber	More Info	T	More Info	N	More Info	More Info	More Info
Group 12	Hydraulic Fluids	Neoprene for Petroleum-Based Fluids Butyl Rubber for Synthetic, Fire Resistant Fluids	More Info	OK (Petroleum-Based Fluids)	OK (Fire-resistant Fluids)	N	More Info	More Info	More Info
Group 13	Greases	Protective Gloves	T	T	T	T	T	T	T
Group 14	Polish/Wax Compounds	Protective Gloves	T	T	T	T	T	T	T
Group 15	Corrosion Preventive Compounds	Rubber	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 16	Antifreeze	Chemical Resistant Neoprene, Natural Latex, or Butyl	More Info	T	T	N	T	More Info	More Info
Group 17	Compressed Gases	None	Consult MSDS for proper PPE, if applicable						
Group 18	Oxidizers	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
Group 19	Fluorescent Lamps	Protective Gloves	T	T	T	T	T	T	T
Group 20	Heavy Metals	Protective Gloves	T	T	T	T	T	T	T

Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing th

Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.

Glove is recommended by NSTM 670 (Vol. 2) HMUG

Glove is acceptable under certain conditions listed in the block

Glove is not recommended for protection against chemicals in this group

Back to the "How to Use This Matrix" Page

Chemical	Chemical Protection Offered by Various Glove Materials*				
	Neoprene	Natural Latex/Rubber	Butyl	Nitrile	Multi-Layer Laminate**
Kerosene	Very Good	Fair	Fair	Very Good	Excellent
Ketones	Good	Very Good	Very Good	Poor	Excellent
Lacquer thinners	Good	Fair	Fair	Poor	Excellent
Lactic acid (85%)	Very Good	Very Good	Very Good	Very Good	Not Tested
Lauric acid (36%)	Very Good	Fair	Very Good	Very Good	Not Tested
Lineolic acid	Very Good	Poor	Fair	Good	Not Tested
Linseed oil	Very Good	Poor	Fair	Very Good	Not Tested
Maleic acid	Very Good	Very Good	Very Good	Very Good	Not Tested
Methyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Methylamine	Fair	Fair	Good	Good	Fair
Methyl bromide	Good	Fair	Good	Fair	Not Tested
Methyl chloride	Poor	Poor	Poor	Poor	Excellent
Methyl ethyl ketone	Good	Good	Very Good	Poor	Excellent
Methyl isobutyl ketone	Fair	Fair	Very Good	Poor	Excellent
Methyl methacrylate	Good	Good	Very Good	Fair	Excellent
Monoethanolamine	Very Good	Good	Very Good	Very Good	Not Tested
Morpholine	Very Good	Very Good	Very Good	Good	Excellent
Naphthalene	Good	Fair	Fair	Good	Excellent
Napthas, aliphatic	Very Good	Fair	Fair	Very Good	Excellent
Napthas, aromatic	Good	Poor	Poor	Good	Excellent
Nitric acid	Good	Fair	Fair	Fair	Excellent
Nitric acid, red and white fuming	Poor	Poor	Poor	Poor	Very Good
Nitromethane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Nitropropane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Octyl alcohol	Very Good	Very Good	Very Good	Very Good	Not Tested
Oleic acid	Very Good	Fair	Good	Very Good	Not Tested
Oxalic acid	Very Good	Very Good	Very Good	Very Good	Excellent
Palmitic acid	Very Good	Very Good	Very Good	Very Good	Not Tested
Perchloric acid (60%)	Very Good	Fair	Good	Good	Excellent
Perchloroethylene	Fair	Poor	Poor	Good	Excellent
Petroleum distillates (Napthas/mineral spirits	Good	Poor	Poor	Very Good	Excellent
Phenol	Very Good	Fair	Good	Fair	Excellent
Phosphoric acid	Very Good	Good	Very Good	Very Good	Excellent
Potassium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl acetate	Good	Fair	Good	Fair	Excellent

Example #1- Corrosion Prevention

- Step #4: Worker Performance and Comfort
  - Suppose this maintenance involves manipulating small screws and other parts, so a relatively high level of dexterity is needed

- Results
  - At the time of this writing, Multi-Layer Laminate gloves are relatively uncommon though they are very protective
    - However, they would be overkill since the task has a low exposure risk (incidental splash)
  - Nitrile is a good choice
    - Due to low exposure risk, thin (4 mil or 8 mil), disposable nitrile gloves are a good choice

Example #2- Toluene

- Suppose an MRC is being developed that requires the use of Toluene, Technical Grade (SPIN #01391)
- Suppose this maintenance task involves high risk of contact with toluene (immersion)
- Which glove provides the appropriate protection?

Example #2- Toluene

- Step #1: Determine specific composition of compound
  - MSDS indicates that toluene (an aromatic hydrocarbon) is the only component of product
- Step #2: Assess the Potential Exposure Risk
  - Suppose maintenance task involves partial immersion of hands in material

Example #2- Toluene

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Toluene is a Solvent = HMUG Group #9
    - HMUG Group #9 recommends “Solvent-Resistant” Gloves (vague… which glove is best depends on which solvent is used)
  - Cross-check glove recommendation in product MSDS
    - MSDS recommends “Use Gloves” (vague!)
- Neither of these recommendations is very specific… we need to keep investigating

Example #2- Toluene

- Step #3 (cont'd): Cross-check Toluene against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #9
  - Scroll down to "Toluene"
  - Select appropriate glove type
    - Multi-layer laminate- Excellent
    - Nitrile- Fair
    - Neoprene- Fair
    - Natural latex- Not Recommended
    - Butyl Rubber- Not Recommended

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Group 6	Cleaning Compounds	Rubber	Y	Y	Y	Y	Y	Y	Y
Group 7	Aerosols	Neoprene	More Info	Y	More Info	N	More Info	More Info	More Info
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Group 19	Fluorescent Lamps	Protective Gloves	Y	Y	Y	Y	Y	Y	Y
Group 20	Heavy Metals	Protective Gloves	Y	Y	Y	Y	Y	Y	Y

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Morpholine	Very Good	Very Good	Very Good	Good	Excellent
Naphthalene	Good	Fair	Fair	Good	Excellent
Napthas, aliphatic	Very Good	Fair	Fair	Very Good	Excellent
Napthas, aromatic	Good	Poor	Poor	Good	Excellent
Nitric acid	Good	Fair	Fair	Fair	Excellent
Nitric acid, red and white fuming	Poor	Poor	Poor	Poor	Very Good
Nitromethane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Nitropropane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Octyl alcohol	Very Good	Very Good	Very Good	Very Good	Not Tested
Oleic acid	Very Good	Fair	Good	Very Good	Not Tested
Oxalic acid	Very Good	Very Good	Very Good	Very Good	Excellent
Palmitic acid	Very Good	Very Good	Very Good	Very Good	Not Tested
Perchloric acid (60%)	Very Good	Fair	Good	Good	Excellent
Perchloroethylene	Fair	Poor	Poor	Good	Excellent
Petroleum distillates (Napthas/mineral spirits	Good	Poor	Poor	Very Good	Excellent
Phenol	Very Good	Fair	Good	Fair	Excellent
Phosphoric acid	Very Good	Good	Very Good	Very Good	Excellent
Potassium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl acetate	Good	Fair	Good	Fair	Excellent
Propyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl alcohol (iso)	Very Good	Very Good	Very Good	Very Good	Excellent
Sodium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Styrene	Poor	Poor	Poor	Fair	Excellent
Styrene (100%)	Poor	Poor	Poor	Fair	Excellent
Sulfuric acid	Good	Good	Good	Good	Excellent
Tannic acid (65%)	Very Good	Very Good	Very Good	Very Good	Not Tested
Tetrahydrofuran	Poor	Fair	Fair	Fair	Excellent
Toluene	Fair	Poor	Poor	Fair	Excellent
Toluene diisocyanate (TDI)	Fair	Good	Good	Fair	Excellent
Trichloroethylene	Fair	Fair	Poor	Good	Excellent
Triethanolamine (85%)	Very Good	Good	Good	Very Good	Excellent
Tung oil	Very Good	Poor	Fair	Very Good	Not Tested
Turpentine	Good	Fair	Fair	Very Good	Not Tested
Xylene	Poor	Poor	Poor	Fair	Excellent

Example #2- Toluene

- Step #4: Worker Performance and Comfort
  - This maintenance task doesn't involve small screws or other parts so a high degree of dexterity is not required
- Results
  - Multi-layer laminate, nitrile, and neoprene are options in this example
  - Again, at the time of this writing, Multi-Layer Laminate gloves are relatively uncommon though they are very protective in tasks with high risk of chemical contact and so would make a good choice for this task, if available
  - Nitrile and neoprene are also options since they provide fair protection.
    - However, since the task involves a high risk of contact with the chemical, it's best to select a thicker version of the glove (13 mil) rather than a thinner version (such as the thin (4 or 8 mil) disposable nitrile) as in the last example

Example #3- Applying Haze Gray Paint

- Suppose an MRC is being developed that requires the application of Paint, Enamel, Haze Gray (SPIN #10483)
- Suppose this maintenance task involves a relatively low risk of contact with paint (incidental splashes)
- Which glove provides the appropriate protection?

Example #3- Applying Haze Gray Paint

- Step #1: Determine specific composition of compound
  - MSDS indicates that the paint solids are dissolved in an n-butyl alcohol
- Step #2: Assess Exposure Risk
  - Maintenance task involves brush/roller application with only an incidental splash exposure hazard

Example #3- Applying Haze Gray Paint

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Haze Gray Paint is a “Paint Material”= HMUG Group #8
    - HMUG Group 8 recommends
      - Neoprene gloves for oil-based paints
      - Any protective glove for water-based paints
      - Haze Gray paint is oil-based
  - Cross-check glove recommendation in product MSDS
    - MSDS recommends use of “Gloves that protect against n-butyl alcohol”
- So, the HMUG recommends neoprene gloves and the MSDS recommends gloves which are protective against n-butyl alcohol

Example #3- Applying Haze Gray Paint

- Step #3, cont'd: Cross-check n-butyl alcohol against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #8
  - Scroll down to "n-butyl alcohol"
    - There is no "n-butyl alcohol" listed!
    - But a Google search indicates that a synonym for n-butyl alcohol is "Butyl alcohol" (which is listed)
  - Select appropriate glove type
    - Multi-layer laminate- Excellent
    - Nitrile- Very Good
    - Neoprene- Very Good
    - Natural latex- Very Good
    - Butyl Rubber- Very Good

NSTM 670 (Vol. 2) HMUG Chemical Group #	NSTM 670 (Vol. 2) HMUG Chemical Group Name	NSTM 670 (Vol. 2) HMUG Hand Protection (Chemical) Recommendation (See Note 1 below)	Chemical Resistant Glove Type						
			Nitrile (Green "OTTO Fuel") Gauntlet Gloves	Neoprene Gloves	Butyl (Synthetic) Rubber "Toxicological Agents Protective" Gloves	PVC Coated Rubber (Chemical/Oil Protective) Gloves	Black Natural Latex Rubber "Industrial" Gloves	8-mil Disposable Nitrile Gloves	4-mil Disposable Nitrile Gloves
			SPIN: 02086	SPIN: TBD	SPIN: 02085	SPIN: 00517	SPIN: 00525	SPIN: 02826 (8 mil thick)	SPIN: 1793 (4 mil thick
Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs.								NOTE: Incidental (Splash) contact only. Replace with new glove if contamination	
Group 1	Acids	Acid-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 2	Alkalies/Bases/Caustics	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 3	Detergents/Soaps	Rubber	T	T	T	T	T	T	T
Group 4	Photographic Chemicals	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 5	Adhesives	Neoprene or Rubber	More Info	T	More Info	N	More Info	More Info	More Info
Group 6	Cleaning Compounds	Rubber	T	T	T	T	T	T	T
Group 7	Aerosols	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
Group 8	Paint Materials (Oil-Based)	Neoprene for Oil-Based Paints Any Protective Glove for Water-Based	More Info	T	More Info	N	More Info	More Info	More Info
Group 9	Solvents	Solvent-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 10	Fuels	Neoprene, Nitrile, or Natural Rubber	T	T	More Info	T	More Info	T	T
Group 11	Lubricants/Oils	Oil-Proof Neoprene or Rubber	More Info	T	More Info	N	More Info	More Info	More Info
Group 12	Hydraulic Fluids	Neoprene for Petroleum-Based Fluids Butyl Rubber for Synthetic, Fire Resistant Fluids	More Info	OK (Petroleum-Based Fluids)	OK (Fire-resistant Fluids)	N	More Info	More Info	More Info
Group 13	Greases	Protective Gloves	T	T	T	T	T	T	T
Group 14	Polish/Wax Compounds	Protective Gloves	T	T	T	T	T	T	T
Group 15	Corrosion Preventive Compounds	Rubber	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 16	Antifreeze	Chemical Resistant Neoprene, Natural Latex, or Butyl	More Info	T	T	N	T	More Info	More Info
Group 17	Compressed Gases	None	Consult MSDS for proper PPE, if applicable						
Group 18	Oxidizers	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
Group 19	Fluorescent Lamps	Protective Gloves	T	T	T	T	T	T	T
Group 20	Heavy Metals	Protective Gloves	T	T	T	T	T	T	T

Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing th

Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.

Glove is recommended by NSTM 670 (Vol. 2) HMUG

Glove is acceptable under certain conditions listed in the block

Glove is not recommended for protection against chemicals in this group

Back to the "How to Use This Matrix" Page

Chemical	Chemical Protection Offered by Various Glove Materials*				
	Neoprene	Natural Latex/Rubber	Butyl	Nitrile	Multi-Layer Laminate**
Acetaldehyde	Very Good	Good	Very Good	Good	Excellent
Acetic Acid	Very Good	Good	Very Good	Good	Excellent
Acetone	Good	Very Good	Very Good	Poor	Excellent
Ammonium Hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Amyl Acetate	Fair	Poor	Fair	Poor	Not Tested
Aniline	Good	Fair	Fair	Poor	Excellent
Benzaldehyde	Fair	Fair	Good	Good	Insufficient Data
Benzene	Poor	Poor	Poor	Fair	Excellent
Butyl Acetate	Good	Fair	Fair	Poor	Excellent
Butyl Alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Carbon Disulfide	Fair	Fair	Fair	Fair	Excellent
Carbon Tetrachloride	Fair	Poor	Poor	Good	Excellent
Castor Oil	Fair	Poor	Fair	Very Good	Not Tested
Chlorobenzene	Fair	Poor	Fair	Poor	Excellent
Chloroform	Good	Poor	Poor	Fair	Excellent
Chloronapthalene	Fair	Poor	Fair	Fair	Excellent
Chromic Acid (50% strength)	Fair	Poor	Fair	Fair	Excellent
Citric Acid (10% strength)	Very Good	Very Good	Very Good	Very Good	Not Tested
Cyclohexanol	Good	Fair	Good	Very Good	Excellent
Dibutyle Pthalate	Good	Poor	Good	Good	Excellent
Diesel Fuel	Good	Poor	Poor	Very Good	Not Tested
Diisobutyl Ketone	Poor	Fair	Good	Poor	Excellent
Dimethylformamide	Fair	Fair	Good	Good	Excellent
Dioctyl Pthalate	Good	Poor	Fair	Very Good	Insufficient Data
Dioxane	Very Good	Good	Good	Good	Excellent
Epoxy resins, dry	Very Good	Very Good	Very Good	Very Good	Not Tested
Ethyl acetate	Good	Fair	Good	Fair	Excellent
Ethyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Ethyl ether	Very Good	Good	Very Good	Good	Excellent
Ethylene dichloride	Fair	Poor	Fair	Poor	Excellent
Ethylene glycol	Very Good	Very Good	Very Good	Very Good	Excellent
Formaldehyde	Very Good	Very Good	Very Good	Very Good	Excellent
Formic acid	Very Good	Very Good	Very Good	Very Good	Very Good
Freon 11	Good	Poor	Fair	Good	Not Tested
Freon 12	Good	Poor	Fair	Good	Not Tested

Example #3- Applying Haze Gray Paint

- Step #4: Worker Performance and Comfort
  - Brush and roller painting doesn't require a high degree of dexterity
  - However, the exposure risk is low so there's no need to burden the maintenance person with an overly thick glove

Example #3- Applying Haze Gray Paint

- Results
  - Multi-layer laminate, nitrile, neoprene, butyl rubber, and natural latex rubber are all good options in this example.
    - Multi-Layer Laminate gloves are relatively uncommon and are way overprotective for this particular application.
    - Neoprene is good but not yet widely available
    - Butyl rubber is very thick and offers low dexterity. Plus, it's relatively expensive.
    - Natural latex rubber is also relatively thick and expensive.
    - Nitrile is good and widely available
      - For this application (where only minimal contact is likely), a thin (4 or 8 mil) disposable nitrile would be fine

Example #4: Multiple Components

- What if we have a chemical product with several different chemical components?

- For example, suppose a paint is comprised of paint solids dissolved in a mixture of solvents?

Example #4- Multiple Components

- Step #1: Determine specific composition of compound
  - MSDS indicates that the paint solids are dissolved in a mixture of n-butyl alcohol, xylene, and toluene solvents
- Step #2: Assess Exposure Risk
  - Maintenance task involves brush/roller application with only an incidental splash exposure hazard

Example #4- Multiple Components

- Step #3: Worker Performance and Comfort
  - Brush and roller painting doesn't require a high degree of dexterity
  - However, the exposure risk is low so there's no need to burden the maintenance person with an overly thick glove

Example #4- Multiple Components

- Step #3: Review Pertinent Resources
  - Determine HMUG group and check HMUG recommendation
    - Haze Gray paint is a “Paint Material”= HMUG Group #8
  - Cross-check glove recommendation in product MSDS
    - Suppose the MSDS recommends use of “Protective Gloves”
      - Again, “protective gloves” is very vague and doesn’t give enough information for a sound decision

Example #4- Multiple Components

- Step #3, cont'd: Cross-check n-butyl alcohol, xylene, and toluene against Chemical Protective Glove Matrix
  - Click on "More Info" in Group #8
  - Scroll down to appropriate rows
    - There is no "n-butyl alcohol" listed!
    - But a Google search indicates that a synonym for n-butyl alcohol is "Butyl alcohol" (which is listed)

NSTM 670 (Vol. 2) HMUG Chemical Group #	NSTM 670 (Vol. 2) HMUG Chemical Group Name	NSTM 670 (Vol. 2) HMUG Hand Protection (Chemical) Recommendation (See Note 1 below)	Chemical Resistant Glove Type						
			Nitrile (Green "OTTO Fuel") Gauntlet Gloves	Neoprene Gloves	Butyl (Synthetic) Rubber "Toxicological Agents Protective" Gloves	PVC Coated Rubber (Chemical/Oil Protective) Gloves	Black Natural Latex Rubber "Industrial" Gloves	8-mil Disposable Nitrile Gloves	4-mil Disposable Nitrile Gloves
			SPIN: 02086	SPIN: TBD	SPIN: 02085	SPIN: 00517	SPIN: 00525	SPIN: 02826 (8 mil thick)	SPIN: 1793 (4 mil thick
Protection offered by each glove type varies depending on the specific chemical used. Click on the "More Info" icons to review the best option for your specific needs.								NOTE: Incidental (Splash) contact only. Replace with new glove if contamination	
Group 1	Acids	Acid-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 2	Alkalies/Bases/Caustics	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 3	Detergents/Soaps	Rubber	T	T	T	T	T	T	T
Group 4	Photographic Chemicals	Rubber	More Info	More Info	T	T	T	More Info	More Info
Group 5	Adhesives	Neoprene or Rubber	More Info	T	More Info	N	More Info	More Info	More Info
Group 6	Cleaning Compounds	Rubber	T	T	T	T	T	T	T
Group 7	Aerosols	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
Group 8	Paint Materials (Oil-Based)	Neoprene for Oil-Based Paints Any Protective Glove for Water-Based	More Info	T	More Info	N	More Info	More Info	More Info
Group 9	Solvents	Solvent-Resistant	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 10	Fuels	Neoprene, Nitrile, or Natural Rubber	T	T	More Info	T	More Info	T	T
Group 11	Lubricants/Oils	Oil-Proof Neoprene or Rubber	More Info	T	More Info	N	More Info	More Info	More Info
Group 12	Hydraulic Fluids	Neoprene for Petroleum-Based Fluids Butyl Rubber for Synthetic, Fire Resistant Fluids	More Info	OK (Petroleum-Based Fluids)	OK (Fire-resistant Fluids)	N	More Info	More Info	More Info
Group 13	Greases	Protective Gloves	T	T	T	T	T	T	T
Group 14	Polish/Wax Compounds	Protective Gloves	T	T	T	T	T	T	T
Group 15	Corrosion Preventive Compounds	Rubber	More Info	More Info	More Info	N	More Info	More Info	More Info
Group 16	Antifreeze	Chemical Resistant Neoprene, Natural Latex, or Butyl	More Info	T	T	N	T	More Info	More Info
Group 17	Compressed Gases	None	Consult MSDS for proper PPE, if applicable						
Group 18	Oxidizers	Neoprene	More Info	T	More Info	N	More Info	More Info	More Info
Group 19	Fluorescent Lamps	Protective Gloves	T	T	T	T	T	T	T
Group 20	Heavy Metals	Protective Gloves	T	T	T	T	T	T	T

Note 1: In some cases, the HMUG gives only one or two specific glove recommendations. The "More Info" icons in this matrix are designed to allow the user greater flexibility in choosing th

Always review the Material Safety Data Sheet (MSDS) and/or product label to determine which chemical components are in the product.

Glove is recommended by NSTM 670 (Vol. 2) HMUG

Glove is acceptable under certain conditions listed in the block

Glove is not recommended for protection against chemicals in this group

Back to the "How to Use This Matrix" Page

Chemical	Chemical Protection Offered by Various Glove Materials*				
	Neoprene	Natural Latex/Rubber	Butyl	Nitrile	Multi-Layer Laminate**
Nitromethane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Nitropropane (95.5%)	Fair	Poor	Fair	Fair	Excellent
Octyl alcohol	Very Good	Very Good	Very Good	Very Good	Not Tested
Oleic acid	Very Good	Fair	Good	Very Good	Not Tested
Oxalic acid	Very Good	Very Good	Very Good	Very Good	Excellent
Palmitic acid	Very Good	Very Good	Very Good	Very Good	Not Tested
Perchloric acid (60%)	Very Good	Fair	Good	Good	Excellent
Perchloroethylene	Fair	Poor	Poor	Good	Excellent
Petroleum distillates (Napthas/mineral spirits	Good	Poor	Poor	Very Good	Excellent
Phenol	Very Good	Fair	Good	Fair	Excellent
Phosphoric acid	Very Good	Good	Very Good	Very Good	Excellent
Potassium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl acetate	Good	Fair	Good	Fair	Excellent
Propyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Propyl alcohol (iso)	Very Good	Very Good	Very Good	Very Good	Excellent
Sodium hydroxide	Very Good	Very Good	Very Good	Very Good	Excellent
Styrene	Poor	Poor	Poor	Fair	Excellent
Styrene (100%)	Poor	Poor	Poor	Fair	Excellent
Sulfuric acid	Good	Good	Good	Good	Excellent
Tannic acid (65%)	Very Good	Very Good	Very Good	Very Good	Not Tested
Tetrahydrofuran	Poor	Fair	Fair	Fair	Excellent
Toluene	Fair	Poor	Poor	Fair	Excellent
Toluene diisocyanate (TDI)	Fair	Good	Good	Fair	Excellent
Trichloroethylene	Fair	Fair	Poor	Good	Excellent
Triethanolamine (85%)	Very Good	Good	Good	Very Good	Excellent
Tung oil	Very Good	Poor	Fair	Very Good	Not Tested
Turpentine	Good	Fair	Fair	Very Good	Not Tested
Xylene	Poor	Poor	Poor	Fair	Excellent
Butyl Alcohol	Very Good	Very Good	Very Good	Very Good	Excellent

Example #4: Multiple Components

	Chemical Protection by Glove Type				
Solvent Component	**Nitrile**	**Neoprene**	**Natural Latex Rubber**	**Butyl Rubber**	**Multi-layer Laminate**
n-butyl alcohol	Very Good	Very Good	Very Good	Very Good	Excellent
Xylene	Fair	Poor	Poor	Poor	Excellent
Toluene	Fair	Fair	Poor	Poor	Excellent

Example #4- Multiple Components

- Results
  - The table in this example shows:
    - Multi-layer laminate provides the best protection against the three solvents.
    - All gloves provide good protection from n-butyl alcohol
    - Neoprene, butyl rubber, and natural latex rubber provide poor protection from at least one solvent in the mixture
    - Nitrile provides Fair to Very Good protection against all of the solvents
  - Nitrile and the Multi-Layer Laminate provide the best protection
    - The Multi-Layer Laminate is relatively uncomfortable and is overkill for the application since the likely exposure hazard is low
    - Nitrile is probably the best option.
      - For this application (where only minimal contact is likely), a thin (4 or 8 mil) disposable nitrile would be appropriate

What if…

- What if neither the HMUG, MSDS, or Chemical Protective Glove matrix gives good guidance on the best glove?

- Support Structure
  - Command Safety Manager/ Safety Officer
    - They may need assistance
      - Supporting Industrial Hygiene or Safety offices
      - Chemical protective glove manufacturers
  - Supporting Naval Sea Logistics Center (NSLC)
    - May need assistance from Naval Safety Center or Navy and Marine Corp Public Health Center

What Next?

- Thorough review of the Chemical Hand Protection Training presentation designed for maintenance personnel and their supervisors is highly encouraged

- The presentation can be downloaded from
  - Naval Safety Center's Safety Officer Training Materials web page (see notes)
  - NAVSEA's Maritime DC and PPE Information Center web page (see notes)

If you have questions or comments regarding this presentation please contact the Naval Safety Center feedback line:

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